CLAIMS

The invention claimed is:

1. A sootblower for cleaning internal components of an industrial boiler while the boiler is in operation, comprising:

a lance tube simultaneously carrying at least two separately controlled cleaning fluid applicators, the lance tube rotating as it delivers separately controlled cleaning fluids to clean the interior components of the boiler;

a drive system for linearly inserting the lance tube into and retracting the lance tube from the boiler while rotating the lance tube; and

a control system for controlling the delivery of one or more of the cleaning fluids.

2. The sootblower of claim 1, wherein a first cleaning fluid comprises steam, further comprising:

a steam tube on which the lance tube is telescopically received, the steam tube configured to deliver steam into an interior cavity of the lance tube;

one or more steam nozzles in fluid communication with the interior cavity of the lance tube for directing the steam out of the lance tube and into the boiler interior;

a steam valve for controlling the delivery of steam to the steam tube; and

a carriage propelled by the drive system for telescopically inserting the lance tube into and retracting the lance tube from the boiler while the lance tube rotates and the steam tube remains stationary.

3. The sootblower of claim 2, wherein a second cleaning fluid comprises water, further comprising:

one or more water conduits located within the interior cavity of the lance tube;

one or more water nozzles in fluid communication with the water conduits for directing a water stream out of the lance tube and into the boiler interior;

a water distributor carried by the carriage for delivering water from a water supply device to the water conduits while the water conduits rotate with respect to the water supply device; and

a water valve for controlling the deliver of water to the water distributor.

4. The sootblower of claim 3, further comprising a flexible link between each water conduit and an associated water nozzle to adjust for different thermal expansion properties exhibited by the lance tube and the water conduits.

5. The sootblower of claim 3, further comprising:

a first separately controlled water valve, water conduit and water nozzle system that is pointed toward the direction of lance insertion; and

a second separately controlled water valve, water conduit and water nozzle system that is pointed toward the direction of lance retraction.

6. The sootblower of claim 3, further comprising:

a rotation motor carried by the carriage for rotating the lance tube;

a linear travel motor carried by the carriage for inserting the lance into and retracting the lance from the boiler interior;

a frame supporting the steam tube and a toothed rack and a rail;

a roller coupled to the carriage and riding on the rail for supporting the linear travel of the carriage; and

a pinion gear driven by the linear travel motor and engaged with the rack for driving the linear travel of the lance tube.

7. The sootblower of claim 6, wherein the water supply device comprises one or more water hoses for delivering the water to the water distributor, further comprising a hose take-up tray supported by the frame and providing a folding linkage supporting the water hoses as the carriage moves along the steam tube.

8. The sootblower of claim 3, wherein the control system comprises a strain gauge measuring the accumulation of ash deposits on an interior boiler component and automatically triggering operation of the sootblower to clean the component upon detection of a predetermined level of accumulation.

9. The sootblower of claim 3, wherein the control system is configured to control the rotation and linear motion of the lance tube to apply a substantially constant progression of the water stream as it contacts an internal boiler component.

10. The sootblower of claim 9, wherein the control system comprises a camera viewing the interior boiler component and automatically discontinuing operation of the sootblower to clean a portion of the component upon detection of successful cleaning.

11. A sootblower for cleaning internal components of an industrial boiler while the boiler is in operation, comprising:

a lance tube having at least two separately controlled water applicators, the lance rotating as it delivers water streams from the separately controlled water applicators to clean interior components of the boiler;

a drive system for linearly inserting the lance tube into and retracting the lance tube from the boiler while rotating the lance tube; and

a control system for controlling the rotation and linear motion of the lance tube to apply a substantially constant progression of the first water stream as it contacts a planar face of a platen positioned perpendicular to the direction of linear motion of the lance as the lance is inserted into the boiler; and

the control system further configured to control the rotation and linear motion of the lance tube to apply a substantially constant progression of the second water stream as it contacts an opposing planar face of the platen as the lance is retracted from the boiler.

12. The sootblower of claim 11, wherein the control system comprises a strain gauge measuring the accumulation of ash deposits on the platen and automatically triggering operation of the sootblower to clean the platen upon detection of a predetermined level of accumulation.

13. The sootblower of claim 12, wherein the control system comprises a camera viewing the platen and automatically discontinuing operation of the sootblower to clean a portion of the platen upon detection of successful cleaning.

14. A sootblower for cleaning internal components of a power plant boiler while the boiler is in operation, comprising:

a frame supporting a steam tube, a toothed rack and a rail;

a lance tube telescopically received on the steam tube, which is configured to deliver steam into an interior cavity of the lance tube;

one or more steam nozzles in fluid communication with the interior cavity of the lance tube for directing the steam out of the lance tube and into the boiler interior;

a steam valve for controlling the delivery of steam to the steam tube;

a carriage configured to telescopically move the lance tube with respect to the steam tube to insert the lance tube into and retract the lance tube from the boiler while the lance tube rotates and the steam tube remains stationary;

first and second water conduits located within the lance tube;

a first water nozzle in fluid communication with the first water conduit for directing a water stream out of the lance tube and into the boiler interior;

a second water nozzle in fluid communication with the second water conduit for directing a water stream out of the lance tube and into the boiler interior;

a water distributor carried by the carriage and having a first pressurized water channel for delivering water from a first water hose to the first water conduit while the first water conduit rotates with respect to the water hose, a first water valve for controlling the deliver of water to the first water conduit, a second pressurized water channel for delivering water from a second water hose to the second water conduit while the water conduit rotates with respect to the water hose, and a second water valve for controlling the deliver of water to the second water conduit;

a rotation motor carried by the carriage for rotating the lance tube while the lance travels along the steam tube;

a linear travel motor carried by the carriage for driving inserting the lance into and retracting the lance from the boiler interior;

a roller coupled to the carriage and riding on the rail for supporting the linear travel of the carriage;

a pinion gear driven by the linear travel motor and engaged with the rack for driving the linear travel of the lance tube; and

a control system for simultaneously controlling rotation of the lance, linear travel of the lance, delivery of the steam, delivery of water from the first set of water nozzles, and delivery of water from the second set of water nozzles.

15. The sootblower of claim 14, further comprising a flexible link between each water conduit and an associated water nozzle to adjust for different thermal expansion properties exhibited by the lance tube and the water conduits.

16. The sootblower of claim 14, further comprising a hose take-up tray supported by the frame and providing a folding linkage to support the first and second water hoses as the carriage moves along the steam tube.

17. The sootblower of claim 14, wherein the first water nozzle points toward the direction of lanced insertion and the second water nozzle points toward the direction of lanced retraction.

18. The sootblower of claim 14, further comprising a control system configured to:

control the rotation and linear motion of the lance tube to apply a substantially constant progression of the first water stream as it contacts a planar face of a platen positioned perpendicular to the direction of linear motion of the lance as the lance is inserted into the boiler; and

control the rotation and linear motion of the lance tube to apply a substantially constant progression of the second water stream as it contacts an opposing planar face of the platen as the lance is retracted from the boiler.

19. The sootblower of claim 14, wherein the control system comprises a strain gauge measuring the accumulation of ash deposits on an interior boiler component and automatically triggering operation of the sootblower to clean the component upon detection of a predetermined level of accumulation.

20. The sootblower of claim 14, wherein the control system comprises a camera viewing an interior boiler component and automatically discontinuing operation of the sootblower to clean a portion of the component upon detection of successful cleaning of the portion.

21. An automatic cleaning system for a power plant boiler, comprising:

boiler monitoring equipment for detecting an ash accumulation condition of the interior of the boiler;

boiler cleaning equipment for cleaning the interior of the boiler while the boiler is in operation comprising at least one multi-media rotating sootblower comprising a lance tube simultaneously carrying at least two separately controlled cleaning fluid applicators, the lance tube rotating as it delivers cleaning fluids through the separately controlled cleaning fluid applicators to clean the interior components of the boiler, and a drive system for linearly inserting the lance tube into and retracting the lance tube from the boiler while rotating the lance tube; and

a control system configured to receive sensor data from the boiler monitoring equipment, determine the ash accumulation condition of the interior of the boiler based on the sensor data, and to generate control signals to automatically activate and control the boiler cleaning equipment in response to the ash accumulation condition.

22. The automatic cleaning system of claim 21, wherein:

the boiler monitoring equipment includes a system of strain gauges configured to measure the weight of accumulated ash deposits on hanging superheater platens within the boiler; and

the control system activates the rotating multi-media rotating sootblower to clean a particular platen in response to strain gauge signals indicating a predetermined weight of accumulated ash deposits on the particular platen.

23. The automatic cleaning system of claim 22, wherein:

the boiler monitoring equipment includes a boiler camera configured to observe the condition of the particular platen during cleaning; and

the control system deactivates the rotating multi-media rotating sootblower for cleaning a portion of the particular platen in response to camera data indicating that the portion of the particular platen has been successfully cleaned.

24. The automatic cleaning system of claim 23, wherein:

the boiler monitoring equipment includes heat transfer gauges configured to measure heat transfer in a furnace section of the boiler; and

the control system activates water cannons to clean the furnace section of the boiler in response to heat transfer gauge data indicating that a predetermined drop in heat transfer has occurred within the furnace section.

25. The automatic cleaning system of claim 24, wherein:

the boiler monitoring equipment includes a furnace camera configured to observe the condition of the furnace during cleaning; and

the control system deactivates the water cannon for cleaning a portion of the furnace section in response to camera data indicating that the portion of the furnace section has been successfully cleaned.

26. The automatic cleaning system of claim 25 further comprising single-media sootblowers for cleaning other sections of the boiler.

27. A power plant having a boiler with a thermal output rating, comprising:

an automatic cleaning system for the boiler configured to automatically clean the boiler to maintain the thermal output rating including;

boiler monitoring equipment for detecting the ash accumulation condition of the interior of the boiler,

boiler cleaning equipment for cleaning the interior of the boiler while the boiler is in operation comprising at least one multi-media rotating sootblower comprising a lance tube simultaneously carrying at least two separately controlled cleaning fluid applicators, the lance tube rotating as it delivers cleaning fluids through the separately controlled cleaning fluid applicators to clean the interior components of the boiler, and a drive system for linearly inserting the lance tube into and retracting the lance tube from the boiler while rotating the lance tube; and

[and] a control system configured to receive sensor data from the boiler monitoring equipment, determine the ash accumulation condition of the interior of the boiler based on the sensor data, and to generate control signals to automatically activate the boiler cleaning equipment in response to the ash accumulation condition.

28. The automatic cleaning system of claim 27, wherein:

the boiler monitoring equipment includes a boiler camera configured to observe the condition of the particular platen during cleaning; and

the control system deactivates the rotating multi-media rotating sootblower for cleaning a portion of the particular platen in response to camera data indicating that the portion of the particular platen has been successfully cleaned.

29. The automatic cleaning system of claim 28, wherein:

the boiler monitoring equipment includes heat transfer gauges configured to measure heat transfer in a furnace section of the boiler; and

the control system activates water cannons to clean the furnace section of the boiler in response to heat transfer gauge data indicating a predetermined drop in heat transfer has occurred within the furnace section.

30. The automatic cleaning system of claim 29, wherein:

the boiler monitoring equipment includes a furnace camera configured to observe the condition of the furnace during cleaning; and

the control system deactivates the water cannon for cleaning a portion of the furnace section in response to camera data indicating that the portion of the furnace section has been successfully cleaned.

31. The automatic cleaning system of claim 30 further comprising single-media sootblowers for cleaning other sections of the boiler.